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INTRODUCTION:

Each major item or subassembly of the MINUTEMAN Weapon System will be analyzed for Safety. The compilation of the Safety Analysis reports will be in this document. Separate volumes will be used to compile analyses in the following major categories:

VOLUME I	Special Analyses
VOLUME II	Engines (Motors)
VOLUME III	Missile-Borne Equipment
VOLUME IV	Re-Entry Vehicle
VOLUME V	Operational Ground Equipment
VOLUME VI	Maintenance Ground Equipment, Including Transportation and Handling Equipment
VOLUME VII	Facilities and Remote Bases

Each volume is sectionalized to permit adding, as they are produced, new analyses without total revision.

THE BOEING COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6007, DEFLECTOR ASSEMBLY BASE HEATING STAGE I

Prepared By H. G. Caley

Supervised By D. A. Robinson
SYSTEM SAFETY ANALYSIS UNIT

Released By
Weapon System Safety Manager N. E. Classon (DATE)

AF04-(647)-289 (CONTRACT NO.) 5-73100-7090-60727-2-6325 (CHARGE NUMBER)

SAFETY ANALYSIS OF FIGURE "A" 6007

DEFLECTOR ASSEMBLY - BASE HEATING STAGE I

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing:

Part Number 35-25876, Deflector Support Assembly, First Stage

1.2 Used On Drawing(s):

21-51725, 21-51750, 21-50150, First Stage Engine

1.3 Sketch:

See Boeing Drawing

1.4 Basic Features:

1.4.1 Physical:

Located between nozzles aft of Engine Aft Closure and consists of Deflector Support Assembly and Deflector.

1.4.2 Purpose:

To deflect hot exhaust gases from Nozzle Control Unit and Engine Aft Closure.

1.4.3 Similarity:

This Figure "A" 6007, Deflector Assembly - Base Heating Stage I, is similar to Figure "A" 6008 and 6006, Deflector Assembly - Base Heating for 2nd and 3rd Stage Engines respectively.

1.5 Changes:

CCP 490 has been incorporated.

2.0 FUNCTIONAL AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment:

This deflector is connected to and protects the aft-closure dome of the first stage engine from the effects of the hot engine exhaust gases.

2.2 Relation to Adjacent Equipment:

This deflector assembly is located between the nozzles and is arranged to prevent conflict with them. It deflects (as much as possible) hot gases discharged by the nozzles and prevents them from entering the space between the engines and from damaging equipment located in this space.

2.3 Man-Machine Interface:

This deflector is installed and insulation is applied to critical surfaces by personnel during engine build-up during missile assembly.

2.4 Event Chart:

This assembly is used throughout first stage powered flight to deflect hot gases exhausted by the nozzles from the nozzle control unit and aft closure.

2.5 Alternate Modes:

None

3.0 This Figure "A" has no direct safety implications or applications, and, therefore, no further analysis documentation is being provided.

R

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6011, "SUPPORT COMPONENTS-ELECTRICAL CABLING - SEPARABLE

PREPARED BY S. Cervanka 4/6/2

SUPERVISED BY D. Robinson

APPROVED BY System Safety Analysis Unit

Released By Weapons System Safety Manager N. E. Classon 5/3/62

5-78100-7090-60727-2-6325

SAFETY ANALYSIS OF FIGURE "A" 6011

SUPPORT COMPONENTS - ELECTRICAL CABLING - SEPARABLE

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing Drawing No. 25-27523
25-27524

1.2 Used on Drawing - Next Assy 21-50150

1.3 Sketch - See Drawings

1.4 Basic Features

1.4.1 Physical

These components are located within and adjacent to the first stage skirt, interstages I-II, and II - III, and at the forward end of the third stage engine. They consist of brackets, thrust fittings, and special fittings.

1.4.2 Purpose

The components support the electrical cables where they pass through the interstage areas. The main support points are at the umbilical connection and at stage disconnects.

1.5 Changes

None

2.0 FUNCTIONAL AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment

Connect to and restrain cables against loads resulting from launching, vibration, and maneuvers. The structure in the interstages and skirt absorbs the reaction loads.

2.0 (Continued)

2.2 Relation to Adjacent Equipment

None of significance

2.3 Man-Machine Interface

Installation only

2.4 Event Chart

Continuous from time of ignition

2.5 Alternate Modes

None

3.0 POTENTIAL CONSEQUENCES OF FAILURE AND/OR ERROR

3.1 Probability of Failure

These are simple structural components built to minimize deflection - hence failure is very unlikely.

3.2 Probability of Error

There is a possibility that the BMS 5-62 cable sheath could be damaged during installation of the support components.

3.3 Loss of Safety

If support components fail to perform their intended functions, the electrical cables will be free to move, thus making them susceptible to damage during flight.

3.4 Direct Results of Loss of Safety

Damaged cables would probably cause erratic flight commands.

3.0 (Continued)

3.5 Indirect Results

None

4.0 SPECIAL SAFETY CONSIDERATIONS

4.1 Safety Equipment

None

4.2 Procedures

None

4.3 Safety Features

None

4.4 Safety Markings

Notes on drawings warn installation personnel to handle cable and fittings carefully to preclude cable damage.

4.5 Emergency Equipment

None

5.0 EVALUATION

5.1 Evaluation

The design and installation procedures for this equipment are adequate from a safety viewpoint.

5.2 Equipment

There are no known shortcomings

5.0 (Continued)

5.3 Equipment Reliability

Essentially 1.0

5.4 Excess

None

5.5 Corrective Action

5.5.1 Mandatory Changes

None

5 5.5.2 Recommended Changes

None

5.6 Deviations from Specifications or other Criteria

None

5.7 Relation to Over-all System Safety

The ability of a missile to make a programmed flight could be affected by the failure of the support components and subsequent cable damage or failure.

6.0 MAINTENANCE OF SAFETY

6.1 Recommended Training

Conduct demonstrations for installation personnel to impress them with proper cable handling techniques, minimum bend radii, etc.

6.2 Inspection Procedures

A detailed inspection will ensure safe operations

.3 Checkout and Tests

None Required

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6501, "INTERSTAGE, 2 - 3 INSTALLATION"

PREPARED BY A. G. Arnold 3/22/2

SUPERVISED BY D. A. Robinson

APPROVED BY

System Safety Analysis Unit (DATE)

Released By N. E. Classon 5/3/2

Weapon System Safety Manager N. E. Classon

5-78100-7090-60727-2-6325

PART NUMBER

SAFETY ANALYSIS OF FIGURE "A" 6501
INTERSTAGE
2 - 3 INSTALLATION

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing:

25-27204-3, Interstage Assembly-Insulated, Interstage II-III

1.2 Used On:

CTLI and Wing I

1.3 Sketch:

Boeing Drawing 25-27203, Sheet 2, Section B5.

1.4 Basic Features:

1.4.1 Physical:

The Interstage is located between Stage 2 and Stage 3. It consists of a truncated cone and stiffeners. Access plates are provided for installing 2nd and 3rd Stage Ignition Safing Pins and for installing CTLI equipment. Also, numerous small accesses and windows are provided.

1.4.2 Purpose:

The function of the Interstage is to align the Second and Third Stage Engines and to maintain them in relative position. It also provides for detachment of the first stage during flight. Lastly, the Interstage detaches itself from the Third Stage Engine.

1.4.3 Similarity:

The 2 - 3 Interstage is similar to the Figure "A" 6701 1 - 2 Interstage and is somewhat similar to the Figure "A" 6901 Skirt.

1.4.4 Other Analyses:

The Figure "A" 6503, Ordnance Assembly Safety Analysis, should be reviewed with this analysis as it is associated with the same items of equipment.

1.5 Changes:

ECP 77, "Lightweight G & C Components for Operational Program" has been proposed. If approved, this change will affect Figure "A" 6501 - Interstage, 6205-Nozzle Control Unit, 6006 - Deflector Assembly, 6202 - Angular Accelerometer, 6207 and 6208 - G & C Cables, 6005 - Raceway Components, 6011 - Support Components, 6507 - Bracket Components and 6304 - CTLI Kit Attachment Installation.

2.0 FUNCTION AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment:

2.1.1 The primary connected Equipments are described in 1.4.2

2.1.2 Figure "A" 6503, Ordnance Assembly - Separation and Skirt Removal, II-III, serves to break apart the separation joints of the Interstage providing both stage separation and skirt removal.

2.1.3 Figure "A" 6020, Arm and Disarm Mechanism-Ordnance Assembly: The purpose of this device is to safe the Stage Separation Ordnance Assembly until it is armed by an electrical signal during the launch countdown. It may be manually safed so that arming is impossible until the safing pin is removed. The location of the arming element is monitored continually after installation of the missile in the Launcher. A "NO-GO" signal will be displayed in the LCC if the safpin is rotated 15 degrees from the safe position.

2.1.4 The Figure "A" 6202, Angular Accelerometer, which serves in guidance and control, is located in the interstage.

2.1.5 Figure "A" 6507 Bracket Component - Cable Disconnect, is attached inside the Interstages. The Figure "A"'s 6207 and 6208 G & C Cables join in the interstage at a disconnect. They are supported by Figure "A" 6011 Support Components and Figure "A" 6005 Raceway Components.

2.1.6 The Figure "A" 6304 CTLI Kit Attachment Installation will be installed in the Interstage before a Confidence Test Launch.

2.2 Relation to Adjacent Equipment:

2.2.1 The Thiokol KR 80003, Safe and Arm Mechanism, Igniter, is located on the Second and Third Stage Engines. The purpose of this device is to safe the igniters so that they

(2.2.1 - cont.)

will not function until armed during the launch countdown. In other respects, this is similar to the Figure "A" 6020, reference 2.1.4. If the Interstage were to fail during the handling of the missile, the igniter could be armed.

2.2.2 The third stage engine nozzles, Figure "A" 6006 Deflector Assembly and Figure "A" 6205 Nozzle Control Unit are located inside the Interstage. At the time of stage separation and of skirt removal, these could be damaged by flying fragments.

2.2.3 A linear shaped charge is used during the CTLI and is located on the Second Stage Engine. If the interstage fails during handling causing detonation of this charge, the engine container will be opened. A large rent will be torn in the side and the propellant will burn with a temperature of approximately 4500°F.

2.3 Man-Machine Interface:

2.3.1 Access plates are provided so that a Safing Pin can be installed in the First Stage and Second Stage Igniters and so that CTLI equipment can be installed. The plates are equipped with quick-removable fasteners which have heads covered with PR 1910. This material remains pliable and so may be removed when it is desired to open the plates. The Ordnance Arm and Disarm Safing Pin is installed through the missile skin.

2.3.2 The most direct structure interface occurs at the time of assembly of the interstage.

2.4 Event Chart:

The Separation and Skirt Removal Ordnance Assembly is ignited by an electrical signal from the G & C Section. The second stage is separated immediately. After a specific time delay, the interstage is split in four pieces and blown away from the third stage.

2.5 Alternate Modes:

None available.

3.0 POTENTIAL CONSEQUENCE OF FAILURE AND/OR ERROR

3.1 Probability of Failure:

Structural Stability. The capability of the structure to support the missile standing erect in the Launcher has been well-founded in the tests of EWA 5275. The capability to withstand dynamic forces has not been demonstrated.

3.2 Probability of Errors:

There are many points for errors in the assembly of this item. The structure is designed sufficiently strong, however, and procedures are such that critical errors will be discovered and the other errors will be inconsequential.

3.3 Less of Safety:

The interstage could fail in transportation and/or handling. It could fail in compression in the Launcher and it could

(3.3 - continued)

fail from buckling during a turn in flight. If the interstage did not separate properly, it might contact the second stage.

3.4 Direct Results of Loss of Safety:

If an engine were to be dropped, detonation would quite likely occur. If it is necessary to replace an interstage because of structural failure in the Launcher, a hazardous condition would result. If a structural failure occurs in flight, friendly peoples on the earth's surface may be endangered or, at least, the missile will fall short of its target. These same results might occur if damage is done to the nozzles or other fixtures on the second stage.

3.5 Possible Indirect Results:

None known.

4.0 SPECIAL SAFETY CONSIDERATION

4.1 Safety Equipment:

The interstage is inherently grounded. Also a jumper is provided to bond the interstage to the engine. No specific safety equipment is required for the structure.

4.2 Procedures:

None required.

(3.3 - continued)

fail from buckling during a turn in flight. If the interstage did not separate properly, it might contact the second stage.

3.4 Direct Results of Loss of Safety:

If an engine were to be dropped, detonation would quite likely occur. If it is necessary to replace an interstage because of structural failure in the Launcher, a hazardous condition would result. If a structural failure occurs in flight, friendly peoples on the earth's surface may be endangered or, at least, the missile will fall short of its target. These same results might occur if damage is done to the nozzles or other fixtures on the second stage.

3.5 Possible Indirect Results:

None known.

4.0 SPECIAL SAFETY CONSIDERATION

4.1 Safety Equipment:

The interstage is inherently grounded. Also a jumper is provided to bond the interstage to the engine. No specific safety equipment is required for the structure.

4.2 Procedures:

None required.

4.3 Safety Features:

Shields are provided to prevent fragments of structure from flying toward the interior of the interstage when the separation joints are ruptured.

4.4 Safety Markings:

The plates provided for access to the ignition safing pins are labelled "Access 3rd State Ignition Safing Pin" and "Access 2nd Stage Ignition and Destruct Safing Pins". The location for safing of the Ordnance Assembly is labelled "Arm and Disarm Safing Pin." The window for the "Arm and Disarm Position Indicator" is so labelled. Other pertinent labels are: "Access 3rd Stage Ignition", "Access 2nd Stage Ignition," "Ordnance Access Door" (5 places), "Access Stage Separation Vent" (3 places) and "Panel Sling Attach" (15 places).

4.5 Emergency Equipment:

None required.

5.0 EVALUATION

5.1 Procedures:

Manufacturing Technical Directive 2-1181, Application of RTV Silicone Heat Protective Insulation (PR 1910), is subject to misinterpretation. Corrective action has been taken to insure that safety information is included.

5.2 Equipment:

It has not been demonstrated that flying fragments will not occur at rupture of the separation joints.

5.3 Equipment Reliability:

Probability of structural integrity ≅ 1

Probability of structural separation of both the stages and of skirt removal = .9994, Source D2-4578, Volume II

5.4 Excesses:

None known.

5.5 Corrective Action:

5.5.1 Mandatory Changes:

None

5.5.2 Recommended Changes:

5.5.2.1 Revise the drawing to indicate specifically the parting agent to be utilized (reference 5.1.1)

5.5.2.2 Continue testing of the separation joints and revise the metal to a softer material as required to ensure that fragmentation will not occur.

5.6 Deviations From Specification:

None known.

5.7 Relation to Over-All System Safety

Structural Rigidity
Joint Separability
Protection of Enclosed Items

6.0 MAINTENANCE OF SAFETY

6.1 Recommended Training:

None

6.2 Inspection Procedures:

None required

6.3 Checkout and Tests:

None required.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6308, INSTALLATION KIT TRAINER TEST GROUP, GUIDED MISSILE

PREPARED BY R. G. Caley 4/5/62

SUPERVISED BY D. A. Robinson 4/9/62

APPROVED BY D. A. Robinson 4/9/62
D. A. Robinson
System Safety Analysis

Released By
Weapons System Safety Manager N. E. Classon 4/3/62

5-78100-7090-60727-2-6325

SAFETY ANALYSIS OF FIGURE A 6308

INSTALLATION KIT TRAINER TEST GROUP, GUIDED MISSILE

1.0 IDENTIFICATION AND DESCRIPTION:

1.1 Boeing:

25-29241, Installation Kit Trainer Test Group, Guided Missile

1.2 Used On:

CTLI missiles - for associated drawings, see listing on drawing 25-29241.

1.3 Sketch:

None

1.4 Basic Features:

1.4.1 Physical:

This Figure A is composed of several parts, including the following: Support Detonating Cord, Jet Perforator Installation, Lanyard Assembly, Bracket Premature Stage Separation and Safe and Arm device, Bracket-Battery and Timer, and Pin Lanyard.

1.4.2 Purpose:

The component parts of this Figure A are located in the interstage sections and are used to support and locate the All Ordnance Destruct System when operational missiles are modified to CTLI configuration.

2.0 FUNCTION AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment:

This equipment is attached to the missile to position and support special CTLI equipment added to operational missiles.

2.2 Relation to Adjacent Equipment:

This equipment has no relation to adjacent equipment, except in case of equipment failure.

2.3 Man-Machine Interface:

The component parts of this kit must be installed on the missile and the various components of the All Ordnance Destruct System are installed on the missile using parts of this kit to position and support the destruct components as required.

2.4 Event Chart:

This equipment is installed at the CTLI Destruct Pack Installation Facility prior to the installation of the All Ordnance Destruct System.

2.5 Alternate Modes:

The All Ordnance Destruct System can be installed during missile assembly using R & D components instead of this kit.

3.0 POTENTIAL CONSEQUENCE OF FAILURE AND/OR ERROR

3.1 Probability of Failure:

This equipment is designed to withstand the stresses induced by missile launch and flight while supporting the various components of the All Ordnance Destruct System.

3.2 Probability of Errors

This equipment is designed to be installed without removal of interstage sections, therefore, installations are made in poorly lighted areas and in cramped quarters with increased probability of errors resulting. Improper installation can result in failure of the equipment to provide proper support or to position the destruct system in the correct location.

3.3 Loss of Safety:

Failure of this equipment or error in the installation could result in failure of part or all of the All Ordnance Destruct System.

3.4 Direct Results of Loss of Safety:

The All Ordnance Destruct System could fail to accomplish its designed purpose if improperly supported or positioned as a result of failure of this equipment.

3.5 Possible Indirect Results:

Failure of the All Ordnance Destruct System could result in impact of missile in unsafe areas.

4.0 SPECIAL SAFETY CONSIDERATIONS

4.1 Safety Equipment:

None

4.2 Procedures:

Installation procedures are adequate,

4.3 Safety Features:

None.

4.4 Safety Markings:

None

4.5 Emergency Equipment:

None

5.0 EVALUATION

5.1 Procedures:

Adequate

5.2 Equipment:

The equipment is designed to withstand stresses resulting from launch and flight manuvers.

5.3 Equipment Reliability:

Not applicable

5.4 Excesses:

None

5.5 Corrective Action:

None Required

5.6 Deviations from Specifications or Other Criteria:

None

5.7 Relation to Over-All System Safety:

Training Kit for operational crews

6.0 MAINTENANCE OF SAFETY

6.1 Recommended Training:

Training in installing this equipment on ground test missiles or mock-ups.

6.2 Inspection Procedures:

Quality Control verification of proper installation

6.3 Checkout and Tests:

Not applicable

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6006, "DEFLECTOR ASSEMBLY - BASE HEATING STAGE III"

PREPARED BY A. G. Arnold

SUPERVISED BY D. A. Robinson

APPROVED BY System Safety Analysis Unit (DATE)

Released By
Weapons System Safety Manager N. E. Classon

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3

SAFETY ANALYSIS OF FIGURE "A" 6006

DEFLECTOR ASSEMBLY - BASE HEATING STAGE III

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing:

Part Number 25-25878, Deflector Support Assembly, Third Stage

1.2 Used On Drawing(s):

21-51725, 21-51750, 21-50150, First Stage Engine

1.3 Sketch:

See Boeing Drawing

1.4 Basic Features:

1.4.1 Physical:

Located between nozzles aft of Engine Aft Closure and consists of Deflector Support Assembly and Deflector.

1.4.2 Purpose:

To deflect hot exhaust gases from Nozzle Control Unit and Engine Aft Closure.

R Edarson 5/3/2

1.4.3 Similarity:

This Figure "A" 6006, Deflector Assembly - Base Heating Stage I, is similar to Figure "A" 6008 and 6007, Deflector Assembly - Base Heating for 2nd and 1st Stage Engines respectively.

1.5 Changes:

COP 490 has been incorporated

2.0 FUNCTIONAL AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment:

This deflector is connected to and protects the aft closure dome of the third stage engine from the effects of the hot engine exhaust gases.

2.2 Relation to Adjacent Equipment:

This deflector assembly is located between the nozzles and is arranged to prevent conflict with them. It deflects (as much as possible) hot gases discharged by the nozzles and prevents them from entering the space between the engines and from damaging equipment located in this space.

2.3 Man-Machine Interface:

This deflector is installed and insulation is applied to critical surfaces by personnel during engine buildup during missile assembly.

2.4 Event Chart:

This assembly is used throughout third stage powered flight to deflect hot gases exhausted by the nozzles from the nozzle control unit and aft closure.

2.5 Alternate Modes:

None

3.0 This Figure "A" has no direct safety implications or applications, and, therefore, no further analysis documentation is being provided.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6008, "DEFLECTOR ASSEMBLY - BASE HEATING STAGE II"

PREPARED BY A. G. Arnold

SUPERVISED BY D. A. Robinson

APPROVED BY System Safety Analysis Unit (DATE)

Released By
Weapons System Safety Manager N. E. Classon 5/3/2

5-78100-7090-60727-2-6325

SAFETY ANALYSIS OF FIGURE "A" 6008

DEFLECTOR ASSEMBLY - BASE HEATING STAGE II

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing:

Part Number 25-25877, Deflector Support Assembly, Second Stage

1.2 Used On Drawing(s):

21-51725, 21-51750, 21-50150, Second Stage Engine

1.3 Sketch:

See Boeing Drawing

1.4 Basic Features:

1.4.1 Physical:

Located between nozzles aft of Engine Aft Closure and consists of Deflector Support Assembly and Deflector.

1.4.2 Purpose:

To deflect hot exhaust gases from Nozzle Control Unit and Engine Aft Closure.

1.4.3 Similarity:

This Figure "A" 6008, Deflector Assembly - Base Heating Stage II, is similar to Figure "A" 6007 and 6006, Deflector Assembly - Base Heating for 1st and 3rd Stage Engines respectively.

1.5 Changes:

CCP 490 has been incorporated.

2.0 FUNCTIONAL AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment:

This deflector is connected to and protects the aft-closure dome of the second stage engine from the effects of the hot engine exhaust gases.

2.2 Relation to Adjacent Equipment:

This deflector assembly is located between the nozzles and is arranged to prevent conflict with them. It deflects (as much as possible) hot gases discharged by the nozzles and prevents them from entering the space between the engines and from damaging equipment located in this space.

2.3 Man-Machine Interface:

This deflector is installed and insulation is applied to critical surfaces by personnel during engine buildup during missile assembly.

2.4 Event Chart:

This assembly is used throughout second stage powered flight to deflect hot gases exhausted by the nozzles from the nozzle control unit and aft closure.

2.5 Alternate Modes:

None

3.0 This Figure "A" has no direct safety implications or applications, and, therefore, no further analysis documentation is being provided.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6303, "TIMER, INTERVAL"

PREPARED BY R. C. Caley

SUPERVISED BY D. A. Robinson

APPROVED BY System Safety Analysis Unit (DATE)

Released By 5/3/62
Weapons System Safety Manager H. E. Classon

5-78100-7090-60727-2-6325

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SAFETY ANALYSIS OF FIGURE "A" 6303

TIMER, INTERVAL

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing

10-20987 Timer, Interval

1.2 Used on Drawings

29-22327-1 and 21-50122 R&D and CTLI missiles only

1.3 Sketch

See Boeing Spec. 10-20987 Timer Interval

1.4 Basic Features

1.4.1 Physical

10-20987-1 I to II interstage, 10-20987-2 II to III interstage consists of an electronic timer which controls two solid-state firing circuit switches.

1.4.2 Purpose

To connect power to the proper destruct package should premature separation occur before the timed interval has elapsed and to disconnect the proper destruct package upon completion of the timed interval.

1.5 Changes

CCP-582, 612, 602 incorporated

2.0 FUNCTION AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment

The Timer Interval (consisting of an electronic timer and 2 solid state switches) controls two firing circuits to the destruct package.

2.0 (Continued)

2.1 (Continued)

Prior to completion of the timer interval operation of the Mechanical Safe and Arm as in premature staging current passes through the two solid state switches and activates the destruct package. Upon completion of the timer interval the two solid state switches are opened preventing flow of current on operation of the Mechanical Safe and Arm as in normal stage separation, thus preventing operation of the destruct system in normal staging and permitting operation of the destruct system in case of premature stage separation.

2.2 Relation to Adjacent Equipment

Proper operation of these units will result in destruction of the leaving stage in case of premature stage separation or preventing the destruction of the leaving stage in case of Normal Stage Separation. Abnormal operation of these units could result in premature stage separation without destruction of the leaving stage, or destruction of a leaving stage during normal staging with possible damage to nozzles of remaining stage.

2.3 Man-Machine Interface

These units are assembled, tested and installed and timer run set for correct time interval 10-20987-1 50 to 60 seconds 10-20987-2 100 to 120 seconds.

2.4 Event Chart

The electronic timers are started by interruption of an electric pulse from the programer group. The interruption starting the timer is the result of missile lift off from the skirt umbilical. The timers during their operating period hold 2 solid state switches are opened preventing destruction of a leaving stage.

2.5 Alternate Modes

The task assigned to this item can be accomplished by a light weight accurate mechanical timer and switch assembly which can operate in the flight environment. The item under analysis has no other use in the system.

3.0 POTENTIAL CONSEQUENCE OF FAILURE AND/OR ERROR

3.1 Probability of Failure

Failure of the electronic timer to open the solid state switches at conclusion of the timer run could result in operation of the destruct system with possible resulting damage to remaining engines. Failure of the timer to hold the solid stage switches closed during normal timer run could result in premature stage separation without destruction of the leaving stage.

3.2 Probability of Errors

Failure to follow proper installation procedure could result in improper installation with resulting failure to operate properly.

3.3 Loss of Safety

Failure of this unit or error in installation with resulting failure in the premature stage separation destruct system could result in the following:

1. An uncontrolled powered stage without a destruct capability
2. A destroyed leaving stage following normal staging with resultant damage to remainging stages.

3.4 Direct Results of Loss of Safety

Loss of safety resulting from either failure or error can result in failure of the missile to perform its assigned mission or in an uncontrolled powered flight of an engine without command or automatic destruct.

3.5 Possible Indirect Results

In case of an uncontrolled powered flight, the engine could impact in an area where considerable damage would result.

4.0 SPECIAL SAFETY CONSIDERATIONS

4.1 Safety Equipment

This item is a necessary part of flight safety hardware and in its self is safety equipment.

4.0 (Continued)

4.2 Procedures

This unit shall be functionally tested according to the functional test document and installed according to the instructions on the installation drawing.

4.3 Safety Features

This item is in it self a range safety item.

4.4 Safety Markings

None

4.5 Emergency Equipment

This item acts as a safety item in times of emergency to terminate thrust of uncontrolled powered engines.

5.0 EVALUATION

5.1 Procedures

Adequate

5.2 Equipment

This unit has no known or suspected shortcomings.

5.3 Equipment Reliability

Each unit shall have a reliability of .9999 for operation during prelaunch and flight sequence.

5.4 Excesses

None

5.5 Corrective Action

5.5.1 Mandatory Changes

None

5.0 (Continued)

5.5.2 Recommended Changes

None

5.6 Deviations from Specification or other Criteria

None

5.7 Relation to Over-All System Safety

This unit is an essential part of a kit added to operational missiles to meet the extra safety requirements imposed on flight test missiles by Missile Test Ranges.

6.0 MAINTENANCE OF SAFETY

6.1 Recommended Training

Installation crews should be trained to follow accepted step-by-step procedures.

6.2 Inspection Procedures

Quality Control inspection and step-by-step installation ensure proper installation.

6.3 Checkout and Tests

Functional test procedure verifies each unit is working properly prior to installation.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6304, "RACEWAY CONDUIT - SUPPORT SET, (CTLI)

PREPARED BY S. Cervenka

SUPERVISED BY B. A. Robinson

APPROVED BY System Safety Analysis Unit (DATE)

Released By
Weapons System Safety Manager N. E. Classon 8/2/62

5-78100-7090-60727-2-6325
PART NUMBER

5-2-62

VIII

D2-12298

1

2

SAFETY ANALYSIS OF FIG "A" 6304

RACEWAY CONDUIT - SUPPORT SET, (CTLI)

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing Drawing 25-29239-1

1.2 Used on Drawing 25-25406

1.3 Sketch

1.4 Basic Features

1.4.1 Physical

The raceway conduit support set is located on the side of each CTLI missile, and forms an extension of the operational raceway. The main components are the raceway covers, caps, and foam supports.

1.4.2 Purpose

The raceway conduit support set encloses the raceway cables, and protects them from launch and in-flight environment.

1.5 Changes

None

2.0 ANALYSIS

This item is essentially identical to the raceway components analysed in Fig "A" 6005. Hence, the results of that analysis are equally applicable to this case.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6706, "BRACKET COMPONENTS-CABLE DISCONNECT, INTERSTAGE I-II"

PREPARED BY S. Cervenka

SUPERVISED BY D. A. Robinson

APPROVED BY
System Safety
Analysis Unit (DATE)

Released By
Weapons System Safety Manager
N. E. Classon

5-78100-7090-60727-2-6325

SAFETY ANALYSIS OF FIGURE "A" 6706

BRACKET COMPONENTS - CABLE DISCONNECT, INTERSTAGE I-II

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing Drawing No. 25-27234

1.2 Used On Drawing

1.3 Sketch - See Drawing

1.4 Basic Features

1.4.1 Physical

These components are located within the I-II interstage. They consist of a welded frame and strut, and a fiberglass guide.

1.4.2 Purpose

These components provide structural support for the electrical cabling staging connector. The fiberglass guide prevents the cable connector plug from damaging the second stage nozzles during I-II stage separation.

1.5 Changes: CCP 490, 582, 612
DRR 2909
ECP 77

2.0 Analysis

This equipment is functionally identical to that described by Fig. A 6507. Hence the results of that analysis are applicable to this case.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6010, "INSULATING COMPONENT, FASTENER AND ASSEMBLY JOINT"

PREPARED BY A. G. Arnold

SUPERVISED BY D. A. Robinson

APPROVED BY System Safety Analysis Unit (DATE)

Released By
Weapons System Safety Manager N. E. Classon

5-78100-7090-60727-2-6325
PART NUMBER

SAFETY ANALYSIS OF FIG "A" 6010

INSULATING COMPONENT, FASTENER & ASSY JOINT

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing Drawing 25-27233 Components, Formed Insulation, Thermal, Fastener & Assy Joints.

1.2 Used On:

BATC - 25-27233-28
CTLI - 25-27233-1
Wing 1 25-27233-1

1.2.1 Associated Drawing

Boeing 25-27212 Components Installation-Formed Thermal Insulations.

1.3 Sketch-See above

1.4 Basic Features

1.4.1 Physical

This insulating component consists of various forms and pieces of BMS 5-62 Rubbbr & BMS 8-78 Epoxy Polyamids. They are utilized in the interfaces between the inter-stages and engine cases and between the skirt and engine case.

1.4.2 Purpose

The pieces of insulation serve as an ablative covering on the surface of the missile to complement the previously bonded ancoat. There pieces are preformed because of economy in installation and for assurance of good quality insulations

1.0 (Continued)

1.5 Changes - None

2.0 FUNCTION & OPERATIONAL SEQUENCE

2.1 Relation to connected equipment-

Serves to protect the surfaces from excessive heat during passage of the missile through the atmosphere.

2.2 Relation to Adjacent Equipment

Interior equipment is protected by virtue of the fact that the surfaces remain intact.

2.3 Man-Machine Interface

The piece of insulation are handled individually when the interfaces, of which they are associated, are assembled & disassembled.

2.4 Event Chart-Not Applicable

2.5 Alternate Modes-None

3.0 This Item has been determined to be non-hazardous and has no system safety implication as designed if used and maintained as described in appropriate maintenance manuals. This item has no direct in-line function to critical or hazardous items. Therefore this safety analysis is considered complete.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO WS-133A

TITLE SAFETY ANALYSIS OF FIGURE A 6507, "BRACKET COMPONENTS - CABLE DISCONNECT, INTERSTAGE II-III"

PREPARED BY S. Cervenka

SUPERVISED BY D. Robinson

APPROVED BY System Safety Analysis Unit

Released By
Weapons System Safety Manager N. E. Classon

5-78100-7090-60727-2-6325

SAFETY ANALYSIS OF FIGURE "A" 6507

BRACKET COMPONENTS - CABLE DISCONNECT, INTERSTAGE II-III

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing Drawing No. 25-27235

1.2 Used On Drawing - 21-50150

1.3 Sketch - See Drawing

1.4 Basic Features

1.4.1 Physical

These components are located within the II-III interstage. They consist of a welded frame and strut and a fiberglass guide.

1.4.2 Purpose

These components provide structural support for the electrical cabling staging connector. The fiberglass guide prevents the cable connector plug from damaging the third stage mozzles during II-III stage separation.

1.5 Changes CCP 490
ECP 77

2.0 FUNCTION AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment.

The connected equipment consists of the electrical cabling staging connector, and the interstage structure. These brackets control the movement of the cabling connectors under loads resulting from missile maneuvers, vibration, and stage separation.

2.0 (Continued)

2.2 Relation to Adjacent Equipment.

The bracket components restrain and guide the electrical plugs and connectors before and during stage separation. This precludes the possibility of damage to the adjacent third stage nozzles.

2.3 Man-Machine Interface

Installation only

2.4 Event Chart

Continuous

2.5 Alternate Modes

None

3.0 POTENTIAL CONSEQUENCES OF FAILURE AND/OR ERROR

3.1 Probability of Failure

The structural components are designed for rigidity and minimum deflection, hence the probability of failure of these components is very slight. The fiberglass guide could fail during the disconnect process if the plug cocked in the guide.

3.2 Probability of Error

Installation procedures are simple-errors are unlikely.

3.3 Loss of Safety

Failure or error would allow connectors to move-this could result in discontinuity. An unrestrained plug could damage the third stage nozzles during stage separation.

3.4 Direct Results of Loss of Safety

Higher cable discontinuity or nozzle damage would result in erratic flight.

3.0 (Continued)

3.5 Indirect Results

None

4.0 SPECIAL SAFETY CONSIDERATIONS

4.1 Safety Equipment

None

4.2 Procedures

No special safety procedures are required

4.3 Safety Features

The basic function performed by these brackets is a safety feature.

4.4 Safety Markings

None

4.5 Emergency Equipment

None

5.0 EVALUATION

5.1 Procedures

The installation procedures are adequate

5.2 Equipment

There are no known or suspected shortcomings in this equipment.

5.3 Equipment Reliability

Essentially 1.0

5.0 (Continued)

5.4 Excesses

None

5.5 Corrective Action

5.5.1 Mandatory Changes

None

5.5.2 Recommended Changes

None

5.6 Deviations from specifications or other criteria

None

5.7 Relation to Over-all System Safety

These components provide a margin of safety necessary to insure that cables, connectors, and nozzles are not damaged during flight and stage separation.

6.0 MAINTENANCE OF SAFETY

6.1 Recommended Training

None

6.2 Inspection Procedures

Procedures to check the fit and alignment of the connector plug in the guide should be incorporated in the assembly instructions.

6.3 Checkout and Tests

None Required

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE SAFETY ANALYSIS REPORT, FIGURE "A" 6005

RACEWAY COMPONENTS, SECTIONS 44 THROUGH 49

PREPARED BY S. Cervenka

SUPERVISED BY D. A. Robinson 5/31/62

APPROVED BY D. A. Robinson 5/31/62 (DATE)

Released by Weapon System Safety Manager N. E. Classon 6/4/62

5-78100-7090-60871-0-26340

CHARGE NUMBER

AF-04(647)-289

Contract Number

SAFETY ANALYSIS OF FIGURE "A" 6005
RACEWAY COMPONENTS, SECTIONS 44 THROUGH 49

1.0 IDENTIFICATION

Model Spec. No. S-133-1000-1-7. Boeing Drawing No. 25-27236, Used On drawings: 21-50150 Serial No. AF 62-2598 and on, and 21-51725 Serial No. GTM 008 and 010; Analysis made of configuration as of May 31, 1962.

2.0 DESCRIPTION

2.1 The raceway cover components consist of insulated channels filled with PE 102 polyether urethane foam (BMS 8-61). The channels run the length of each stage, and terminate in caps at each interstage skirt. The components are sealed with BMS 5-62 for pressure tightness and aerodynamic smoothness. These components support and protect the raceway cables.

2.2 The raceway cover components house the raceway cables. They protect the cables from heat and abrasion and provide support to prevent excessive cable loads during vibration. The raceway caps cover the cable access holes in the interstage skirts. The covers are bolted to the engine cases but do not affect the engine operation in any way. The stage separation charges and all devices inside the interstages are dependent on the the raceway caps and sealing for protection from excessive heat.

3.0 SAFETY CONTROLS INCORPORATED

Covers and caps are insulated and sealed to prevent the entrance of flames or excessive heat.

4.0 HAZARD AND POTENTIAL AFFECTS TO PERSONNEL AND/OR EQUIPMENT

4.1 There is a remote possibility: 1. that a raceway cover or cap could deform during silo overpressure; 2. of an error in installing the covers. If these were improperly sealed, a path could be left open for flames to follow at launch; 3. that the insulation could be damaged during missile emplacement or during maintenance operations.

4.2 In the event of a failure or error of the type described above, it would be possible for flames to enter the raceway area. Flames and excessive temperatures inside the interstage could set off the stage separation charge. Burning of the foam (it will burn slowly in free air) or abrasion of the cables from a deformed cap would cause cable damage. This damage could cause erratic flight.

4.3 Stress analysis and testing indicate that this equipment is adequate to perform its intended function. Failures and errors considered herein are only remote possibilities. In addition, the time spent in the flame and high temperature area is so short that it is unlikely that there would be serious consequences even if a failure did occur. Reliability is considered essentially 1.0.

5.0 CORRECTIVE ACTION REQUIRED

The safety of this equipment is dependent on correct installation, sealing, and insulation.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE WS-133A SAFETY ANALYSIS REPORT (FIGURE "A" 6703)

ORDNANCE SEPARATION INTERSTAGE I-II

PREPARED BY _____ DATE
R. G. Caley

SUPERVISED BY D. A. Robinson 6/4/62
D. A. Robinson

APPROVED BY D. A. Robinson 6/4/62
D. A. Robinson (DATE)

Released by Weapon
System Safety Manager _____
N. E. Classon

5-78100-7090-60871-0-26340
CHARGE NUMBER

AF 04 (647) -289
Contract Number

SAFETY ANALYSIS OF FIGURE "A" 6703

ORDNANCE SEPARATION INTERSTAGE I-II

1.0 IDENTIFICATION AND DESCRIPTION

1.1 This Figure "A" includes necessary linear charge, "H" shaped booster, time delays, Safe & Arm device, and detonator assembly required to explosively separate the I-II interstage and remove the 2nd stage engine skirt at the proper time and includes the following part numbers:

1.1.1	Detonator Assembly	10-20451-5
1.1.2	Linear Explosive	10-20451-
1.1.3	Time Delay Boosters	10-20870
1.1.4	"H" Boosters	10-20870
1.1.5	Mechanical Safe & Arm Mechanisms	25-25218
1.1.6	Linear Explosive Assemblies	10-20870

1.2 Used On:

I-II Interstage, Operational, CTLI and R&D stage separation and skirt removal.

1.3 Sketch:

See Boeing Drawing 25-22897

1.4 Basic Physical Features:

The Ordnance Separation Interstage I-II (Fig. "A" 6703) is identical to the Ordnance Separation Interstage II-III (Fig. "A" 6503) except for the length of various pieces of linear explosive, linear explosive assemblies, and the length of time delay boosters operate. This Fig. "A" includes electrically actuated detonators, lead covered linear explosives, pryotechnic time delays, mechanically operated Safe and Arm device, "H" Booster, and linear explosive assemblies consisting of lead covered linear explosive cut to length and attached to Boosters.

2.0 FUNCTION AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment:

At the proper time an electric pulse is sent from the G & C Section thru the raceway wiring to the arm-disarm unit 10-20436 (Fig. "A" 6702) then to the electrically actuated detonator assembly (10-20451). The detonators which make up the assembly ignite the linear charge from each end (either end is sufficient to insure ignition of the linear explosive). This cuts the interstage between the 1st and 2nd stage engines and ignites the pryotechnic time delay boosters of the skirt removal section. The physical separation of the two sections of the interstage arms · · the mechanical Safe and Arm device, removes the metal barrier and moves explosive pellets in line with the time delay boosters. Upon completion of the time delay boosters' burning time, the pellets in the Safe & Arm device are ignited and in turn ignite the "H" booster which then ignites the linear explosive extensions of the forward circumferential cutting charge. This then separates the forward edge of the skirt from the aft portion of the 2nd stage engine and ignites the boosters attached to the (4) four longitudinal linear explosive cutting assemblies (10-20870-). The skirt is cut in (4) four segments for removal without damage to the remaining portions of the 2nd stage engine.

2.2 Relation to Adjacent Equipment:

2.2.1 Normal Operation:

The Ordnance Separation Interstage I-II will separate the 1st and 2nd stage engines in flight on command and later remove the 2nd stage engine or connected equipment.

2.2.2 Abnormal Operation:

Failure or slow operation of the stage separation could cause pressure buildup resulting in improper separation, possible loss of missile, damage to 2nd stage engine nozzles or nozzle control unit, loss of range, or erratic flight. Failure of the skirt removal system following successful stage separation will result in loss of range. Premature operation can result in personnel injury, loss of missile, or damage to nearby equipment. Note operation of the stage separation system without resulting physical separation of the two stages will not actuate the skirt removal system.

2.3 Man-Machine Interfade:

Stage Separation and Skirt Removal Ordnance is installed in the missile interstage according to procedures included on Boeing Drawing 25-22897, Detonators will be tested according to the instructions in Boeing Document D2-5683 and all ordnance devices will be removed according to instructions contained in Boeing Document D2-9133.

2.4 Event Chart:

This system functions on receipt of signal from G & C section at the proper time for separation of 1st stage engine, which in turn initiates pyrotechnic time delay booster selected to give correct time after 2nd stage engine ignition and before 2nd stage engine skirt removal.

2.5 Alternate Modes:

None

3.0 POTENTIAL CONSEQUENCE OF FAILURE AND/OR ERROR

3.1 Probability of Failure:

The inspection, test, and installation of this system by qualified ordnance installers using step by step procedures supervised by Quality Control Inspectors will reduce or eliminate installation errors. However, an estimated number or occurance rate of errors can not yet be determined.

3.2 Probability of Errors:

Not determined.

3.3 Loss of Safety:

Improper installation could result in premature firing or failure to fire on proper signal. Improper installation of the Mechanical Safe and Arm device could cause failure in either of two modes; the S & A could fail to operate resulting in failure of the Skirt Removal System; or the S & A could be actuated prematurely or accidentally resulting in possible missile collapse in case of premature ignition of the stage separation system.

3.4 Direct Results of Loss of Safety:

Premature ignition can cause possible missile collapse, personnel injury, equipment damage, fire, or explosion. Failure of the system to ignite can cause loss of missile due to erratic flight resulting from improper separation.

3.5 Possible Indirect Results:

Damage to missile, personnel, transporter, missile collapse in the launcher, and uncontrolled missile flight are all possible in case of premature ignition. Failure at the system can result in international incidents, failure of the missile to achieve its objective, and possibly can pose a hazard to civilian life and property.

4.0 SPECIAL SAFETY CONSIDERATIONS

4.1 Safety Equipment:

The safe installation of this system requires the use of detonator protective chambers, arm-disarm unit safing pin, no-voltage test sets, ordnance installation kits, and the use of step by step procedures. No special grounding provisions are provided for this system beyond the use of twisted shielded firing leads, metal to metal contact between the mechanical S & A and the missile interstage, and location of the linear explosive charges in a metalic housing integral with the interstage metal skin.

4.2 Procedures:

Step by step installation procedures are included in Boeing drawing 25-22897 and step by step removal procedures are included in D2-9133.

4.3 Safety Features:

Safing pins are included in the design of Arm-Disarm device (Fig. A 6702) and a lanyard operated Safe and Arm device is used to provide a physical barrier in the explosive train preventing inadvertent or premature firing of the stage separation system from igniting the Skirt Removal System. The mechanical Safe & Arm device requires a 75 lb. pull to operate from the Safe to Armed position. The interstage structure is so designed that operation of either stage separation or Skirt Removal alone should not cause missile collapse, operation of both systems will not necessarily cause missile collapse.

4.4 Safety Markings:

All explosive ordnance items are marked with Standard Ordnance markings; yellow letters on an olive drab background, white letters on brown background, and black letters on yellow background carrying lot and loading number information.

4.5 Emergency Equipment:

The only emergency equipment included in this system is the Safing Pin installed in the Arm-Disarm Unit (Fig. A 6702) which can be used to safe the system in an emergency by locking the Unit in the Safe position which disrupts the firing lines and shorts the firing leads to the detonator assembly.

5.0 EVALUATION

5.1 Procedures:

The use of trained ordnance handlers following approved step by step procedures inspected by trained Quality Control Inspectors and the use of the safety devices provided will provide as safe a system as can be expected where it is mandatory that explosives be handled, trimmed and installed.

5.2 Equipment:

The Stage Separation Linear explosive is ignited by two detonators, two pyrotechnic time delays are used to ignite the "H" shaped booster which in turn ignites the Skirt Removal linear shaped charge at two points thus increasing the assurance the system will perform as designed.

5.3 Equipment Reliability:

The established reliability goal for the ordnance portions of this system is .994. No number goal has been determined or developed for the reliability that the skirt panels will be removed without damage to critical parts of the missile.

5.4 Excesses:

None apparent.

5.5 Corrective Action:

Increased training in Minuteman Ordnance handling procedures and the use of only qualified Minuteman Ordnance installers.

5.6 Deviations from Specification:

None

5.7 Relation to Over-all System Safety:

Detonators meet Minuteman standards 1 amp no fire for 15 seconds, and all ordnance is marked to conform with standard ordnance markings.

6.0 MAINTENANCE OF SAFETY

6.1 Recommended Training:

All installation, removal, and test personnel should be qualified Minuteman Ordnance handlers, qualification should be achieved through both applicable Minuteman training courses and on the job training.

6.2 Inspection Procedures:

Quality Control personnel witnesses and signs off installation based on step by step installation procedures.

6.3 Checkout and Test:

Electric continuity tests only after installation.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE WS-133A SAFETY ANALYSIS REPORT - FIGURE "A" 6016

MARKER SET, SAFE & ARM PINS

PREPARED BY R. G. Caley

SUPERVISED BY D. A. Robinson 5/31/62

APPROVED BY D. A. Robinson 5/31/62 (DATE)

Released by Weapon System Safety Manager N. E. Classon 10/29/62

5-78100-7090-60871-0-26340

AF 04 (647) -289
Contract Number

SAFETY ANALYSIS OF FIGURE "A" 6016
MARKER SET, SAFE & ARM PINS

1.0 IDENTIFICATION

Identification Spec. S-133-1000-1-15; Boeing Dwg: Lanyard and Streamer Assembly 29-21891 & 29-21890; used on WS-133A Safe and Arm and Arm-Disarm safing pins. This analysis is of the configuration as of June 25, 1962.

2.0 DESCRIPTION

The Marker Set is composed of streamers of cloth with nylon lanyard attached. The streamers are attached to the missile safing pins to give visual indication that missile Safe and Arm, and Arm-Disarm safing pins are installed, locking the devices in the safe position without actual physical inspection.

Safe and Arm devices arrive with safing pins installed. Lanyard and streamer assemblies are attached to safing pins during missile assembly. Safing pins with lanyard and streamer assemblies are removed when the missile is emplaced in a launch facility checked out and prepared for alert status. Safing pins with lanyard and streamer assemblies attached are reinstalled in the missile safe and arm devices whenever tests or maintenance which could cause accidental or inadvertant ignition are performed and whenever the missile is to be removed for recycle. Safing pins and lanyard and streamer assemblies remain installed on the missile until the missile is ready to be returned to alert status.

3.0 SAFETY CONTROLS INCORPORATED

The nylon lanyard has a ten pound breaking strength to prevent accidental damage to the safing pin and preclude safing pin removal without use of the proper tool.

4.0 HAZARDS AND POTENTIAL AFFECTS TO PERSONNEL AND/OR EQUIPMENT

The streamer in itself is a safety indicator providing a quick visual indication as to whether Safe and Arm Pins are installed or removed.

NOTE: The presence of red streamers does not provide positive assurance that missile Safe and Arm Pins have been properly installed but only that they are present and presumed to be installed.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO WS-133A

TITLE SAFETY ANALYSIS REPORT, FIGURE "A" 6020

MECHANICAL ARM-DISARM SEPARATION SWITCH

PREPARED BY R. G. Caley

SUPERVISED BY D. A. Robinson

APPROVED BY D. A. Robinson (DATE)

Released by Weapon System Safety Manager W. E. Classon

5-78100-7090-60871-0-26340

PART NUMBER

AF 04 (647) -289

Contract Number

SAFETY ANALYSIS OF FIGURE "A" 6020
MECHANICAL ARM-DISARM SEPARATION SWITCH

1.0 IDENTIFICATION

Boeing Drawing No. 10-20436 Safety and Arming Device, Guided Missile Body Section.

Analysis as of July 11, 1962.

2.0 DESCRIPTION

2.1 The device is an electrically actuated switch in firing circuit with stage separation ordnance, capable of manual safing but incapable of being manually armed.

2.2 The device is armed electrically by signal from sequence and monitor during count down; passes signal from G&C at proper time to initiate action by igniting detonators and stage separation explosives, resulting in stage separation and also igniting of pyrotechnic time delay for skirt removal. Action is same, only time is different for each interstage. The switch has two positions; "safe" or "armed".

3.0 SAFETY CONTROLS INCORPORATED

3.1 The arm-disarm switch is an item of safety equipment. It is designed to receive a manually inserted safing pin which locks the arm-disarm switch in the safe position. It is electrically grounded by bolting the metal case of the switch to the metal interstage.

3.2 Position indicator window shows armed or safe position of the switch; a safety streamer indicates presence of safing pin.

3.3 Arm-Disarm unit meets Minuteman safe and arm mechanism criteria.

3.4 Safing pin installation and removal, including manual safing procedures, are included in Document D2-9133.

4.0 HAZARDS AND POTENTIAL AFFECTS TO PERSONNEL AND/OR EQUIPMENT

4.1 Human errors can occur in installation, improper electrical hookup, failure to remove or install safing pin at proper time. Such errors could cause a spurious electrical signal to the switch, resulting in premature arming and subsequent ignition of stage separation explosives.

4.2 Failure of stage separation can result in loss of missile, erratic flight, shortened range, damage to test and transportation equipment and injury to personnel.

5.0 CORRECTIVE ACTION REQUIRED

5.1 Minuteman ordnance handlers school plus on the job training installing stage separation ordnance devices.

5.2 Installation by trained ordnance handlers and inspected by ordnance trained Quality Control inspectors. Safing pin installed and left in place during ordnance installations.

5.3 All components tested prior to complete installation.

5.4 Complete functional test of arm-disarm switch prior to installation. Continuity test of circuitry prior to ordnance installation.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS-133A

TITLE WS-133A SAFETY ANALYSIS REPORT - FIGURE "A"6503

ORDNANCE SEPARATION INTERSTAGE II - III

PREPARED BY R. G. Caley

SUPERVISED BY D. A. Robinson

APPROVED BY D. A. Robinson (DATE)

Released by Weapon System Safety Mgr. N. E. Classon

5-78100-7090-60871-0-26340

(PART NUMBER)

AF 04 (647) -289
Contract Number

SAFETY ANALYSIS OF FIGURE "A" 6503

ORDNANCE SEPARATION INTERSTAGE II - III

1.0 IDENTIFICATION

1.1 Boeing Drawing 25-22897, Sheets 1 - 4, Ordnance Instllation - Joint Severance Interstage 1-2 & 2-3.
Date of analysis August 15, 1962.

1.2 This Figure "A" includes necessary linear charge, "H" shaped booster, time delays, Safe & Arm device, and detonator assembly required to explosively separate the II-III interstage and remove the 3rd stage engine skirt at the proper time and includes the following drawing numbers:

Detonator Assembly	10-20451
Linear Explosive	10-20451
Time Delay Boosters	10-20870
"H" Boosters	10-20870
Mechanical Safe & Arm Mechanisms	25-25218
Linear Explosive Assemblies	10-20870

1.3 Used On:
Missile II-III Interstage, Operational, CTLI and R & D stage separation and skirt removal.

2.0 DESCRIPTION

2.1 The Ordnance Separation Interstage II-III (Fig. "A" 6503) is identical to the Ordnance Separation Interstage I-II (Fig. "A" 6703) except for the length of various pieces of linear explosive, linear explosive assemblies, and the length of time delay boosters operate. This Fig. "A" includes electrically actuated detonators, lead covered linear explosives, pryotechnic time delays, mechanically operated Safe and Arm device, "H" Booster, and linear explosive assemblies consisting of lead covered linear explosive cut to length and attached to Boosters.

2.2 The Ordnance Separation Interstage II-III will separate the 2nd and 3rd stage engines in flight on command, and later remove the 3rd stage engine skirt.

2.2.1 At the proper time an electric pulse is sent from the G&C Section, thru the raceway wiring, to the arm-disarm unit 10-20436 (Fig. A 6020), then to the electrically actuated detonator assembly (10-20451). The detonators which make up the assembly ignite the linear charge from each end (either end is sufficient to insure ignition of the linear explosive). This cuts the interstage between the 2nd and 3rd stage engines and ignites the pryotechnic time delay boosters of the skirt removal section. The physical separation of the two sections of the interstage arms the mechanical Safe and Arm device, removes the metal barrier and moves explosive pellets in line with the time delay boosters. Upon completion of the time delay boosters' burning time, the pellets in the Safe & Arm device are ignited, and in turn ignite the "H" booster, which then ignites the linear explosive extensions of the forward circumferential cutting charge. This then separates the forward edge of the skirt from the aft portion of the 3rd stage engine and ignites the boosters attached to the (4) four longitudinal linear explosive cutting assemblies (10-20870). The skirt is cut in (4) four segments for removal without damage to the remaining portions of the 3rd stage engine.

2.3 Stage Separation and Skirt Removal Ordnance is installed in the missile interstage according to procedures included on Boeing Drawing 25-22897, Detonators will be tested according to the instructions in Boeing Document D2-5683 and all ordnance devices will be removed according to instructions contained in Boeing Document D2-9133.

3.0 SAFETY CONTROLS INCORPORATED

3.1 Safing pins are included in the design of Arm-Disarm device (Fig. A 6020) and a lanyard operated Safe and Arm device is used to provide a physical barrier in the explosive train preventing inadvertent or premature firing of the Stage Separation System from igniting the Skirt Removal System. The mechanical Safe & Arm device requires a 75 lb. pull to operate from the Safe & Armed position.

3.2 All explosive ordnance items are marked with Standard Ordnance markings yellow letters on an olive drab background carrying lot and loading number information.

3.3 The safe installation of this system requires the use of detonator protective chambers, arm-disarm unit safing pin, no-voltage test sets, ordnance installation kits, and the use of step by step procedures. No special grounding provisions are provided for this system beyond the use of twisted shielded firing leads, metal to metal contact between the mechanical S&A and the Missile interstage, and location of the linear explosive charges in a metalic housing integral with the interstage metal skin.

3.4 Step by step installation procedures are included in Boeing Drawing 25-22897 and step by step removal procedures are included in D2-9133.

3.5 The only emergency equipment included in this system is the Safing Pin installed in the Arm-Disarm Unit (Fig. A 6020) which can be used to safe the system in an emergency by locking the Unit in the Safe position which disrupts the firing lines and shorts the firing leads to the detonator assembly.

3.6 The inspection, test, and installation of this system by qualified ordnance installers using step by step procedures supervised by Quality Control Inspectors will reduce or eliminate installation errors. However, an estimated number of occurance rate of errors cannot yet be determined.

4.0 HAZARDS AND POTENTIAL AFFECTS TO PERSONNEL AND/OR EQUIPMENT

4.1 Failure or slow operation of the stage separation could cause pressure buildup resulting in improper separation, possible loss of missile, damage to 3rd stage engine nozzles or nozzle control unit, loss of range, or erratic flight. Failure of the skirt removal system following successful stage separation will result in loss of range. Note: operation of the stage separation system without resulting physical separation of the two stages will not actuate the skirt removal system.

4.2 Improper installation could result in premature firing or failure to fire on proper signal. Improper installation of the Mechanical Safe and Arm device could cause failure in either of two modes: the S&A could fail to operate resulting in failure of the Skirt

3.2 All explosive ordnance items are marked with Standard Ordnance markings yellow letters on an olive drab background carrying lot and loading number information.

3.3 The safe installation of this system requires the use of detonator protective chambers, arm-disarm unit safing pin, no-voltage test sets, ordnance installation kits, and the use of step by step procedures. No special grounding provisions are provided for this system beyond the use of twisted shielded firing leads, metal to metal contact between the mechanical S&A and the Missile interstage, and location of the linear explosive charges in a metalic housing integral with the interstage metal skin.

3.4 Step by step installation procedures are included in Boeing Drawing 25-22897 and step by step removal procedures are included in D2-9133.

3.5 The only emergency equipment included in this system is the Safing Pin installed in the Arm-Disarm Unit (Fig. A 6020) which can be used to safe the system in an emergency by locking the Unit in the Safe position which disrupts the firing lines and shorts the firing leads to the detonator assembly.

3.6 The inspection, test, and installation of this system by qualified ordnance installers using step by step procedures supervised by Quality Control Inspectors will reduce or eliminate installation errors. However, an estimated number of occurance rate of errors cannot yet be determined.

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4.2 Improper installation could result in premature firing or failure to fire on proper signal. Improper installation of the Mechanical Safe and Arm device could cause failure in either of two modes: the S&A could fail to operate resulting in failure of the Skirt

4.2 Cont'd.

Removal System; or the S&A could be actuated prematurely or accidentally resulting in missile collapse in case of premature ignition of the stage separation system.

4.2.1 Premature ignition can cause missile collapse, personnel injury, equipment damage, fire, or explosion. Failure of the system to ignite can cause loss of missile due to erratic flight resulting from improper separation.

4.2.2 Damage to missile, personnel, transporter, missile collapse in the launcher, and uncontrolled Missile Flight are all possible in case of premature ignition. Failure of the system can result in international incidents, failure of the Missile to achieve its objective, and possibly can pose a hazard to civilian life and property.

5.0 CORRECTIVE ACTION REQUIRED

5.1 The use of trained ordnance handlers following approved step by step procedures, inspected by trained Quality Control Inspectors, and the use of the safety devices provided will provide safety in a system where it is mandatory that explosives be handled, trimmed and installed.

5.2 The Stage Separation Linear explosive is ignited by two detonators. Two pyrotechnic time delays are used to ignite the "H" shaped booster, which in turn ignites the Skirt Removal linear shaped charge at two points, thus increasing the assurance the system will perform as designed.

5.2.1 Detonators meet Minuteman standards 1 amp no fire for 15 seconds, and all ordnance is marked to conform with standard ordnance markings.

5.3 The established reliability goal for the ordnance portions of this system is .994. No number goal has been determined or developed for the reliability that the skirt panels will be removed without damage to critical parts of the Missile.

5.4 The following recommendations are considered mandatory:

5.4.1 Increase training in Minuteman Ordnance handling procedures and the use of only qualified Minuteman Ordnance installation personnel.

5.4.2 All Electric continuity tests shall be made only after installation.

5.4.3 Quality Control personnel shall witness and sign off installation based on step by step installation procedures.

5.5 It is further recommended that all installation, removal, and test personnel should be Qualified Minuteman Ordnance handlers. Qualification should be achieved through both applicable Minuteman training courses and on the job training.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO WS-133A

TITLE SAFETY ANALYSIS REPORT, FIGURE "A" 6701

INTERSTAGE ASSEMBLY - INSULATED I - II

PREPARED BY A. G. Arnold 5-28-62

SUPERVISED BY D. A. Robinson

APPROVED BY D. A. Robinson

Released by Weapon System Safety Manager N. E. Classon

5-78100-7090-60871-0-26340

AF 04 (647) -289
Contract Number

SAFETY ANALYSIS OF FIGURE "A" 6701
INTERSTAGE ASSEMBLY - INSULATED I - II

1.0 IDENTIFICATION

1.1 Boeing Drawing 25-27201, Interstage Assembly - Insulated, Interstage 1 - 2. Model Spec. S-133-1000-1-2. Date of analysis August 16, 1962.

1.2 Used on all missiles. See Boeing Drawing 25-27200, Sheet 2, Section B8 and B10.

2.0 DESCRIPTION

2.1 This interstage is located between Stage 1 and Stage 2 of the missile. It consists of a truncated cone and stiffeners.

2.1.1 Access plates are provided so that a Safing Pin can be installed in the First Stage Igniter and so that CTLI equipment can be installed. The plates are equipped with quick-removable fasteners which have heads covered with PR 1910. This material remains pliable and so may be removed when it is desired to open the plates. The Ordnance Arm and Disarm Safing Pin is installed through another small access hole. Other small accesses and windows are provided for inspection.

2.2 The function of the Interstage is to physically align the First and Second Stage Engines and to maintain their relative position. It also provides for separation of the first stage during missile flight. Lastly, the Interstage separates itself from the Second Stage Engine.

2.3 The 1 - 2 Interstage is similar to the Figure "A" 6501 2 - 3 Interstage.

2.4 The Figure "A" 6701 should be reviewed with the following Figure "A" items which are associated with the function of this interstage.

2.4.1 Figure "A" 6703, Ordnance Assembly - Separation and Skirt Removal, serves to break apart the separation joints of the Interstage providing both stage separation and skirt removal. The Ordnance Assembly is ignited by an electrical signal from the G & C Section. The first stage is separated immediately. After a specific time delay, the interstage is split in four pieces and blown away from the second stage.

2.4.2 Figure "A" 6020, Arm and Disarm Mechanism - Ordnance Assembly: The purpose of this device is to safe the Stage Separation Ordnance Assembly (Figure "A" 6703), until it is armed by an electrical signal during the launch countdown. It may be manually safed so that arming is impossible until the safing pin is removed.

2.4.3 Figure "A" 6706, Bracket Component - Cable Disconnect, is attached inside the Interstages. The Figure "A"'s 6206 and 6207, G&C Cable, join in the interstage at a disconnect. They are supported by the Figure "A" 6011, Support Components, and Figure "A" 6005, Raceway Components.

2.4.4 The following equipment will be installed in the Interstage before a Confidence Test Launch: Figure "A" 6302 Cable Assembly Set, Figure "A" 6303 Timers-Interval, Figure "A" 6304 CTLI Kit Attachment Installation, Figure "A" 6306 Installation Kit-Trainer, Figure "A" 6307 Cable Assembly, Figure "A" 6308 Installation Kit Trainer, Figure "A" 6310 Battery, and the linear charge of the All Ordnance Destruct System.

2.4.5 The Thiokol KR 80003, Safe and Arm Mechanism, Igniter, is located on the dome of the First Stage Engine. The purpose of this device is to safe the engine igniter so that it will not function until armed during the launch countdown. In other respects, this is similar to the Figure "A" 6020. If the Interstage were to fail during the handling of the missile, the igniter could be armed.

2.4.6 The Second Stage Engine nozzles, Figure "A" 6008 Deflector Assembly, and Figure "A" 6204 Nozzle Control Unit are located inside the Interstage. At the time of stage separation and of skirt removal, these could be damaged by flying fragments.

2.4.7 The Thiokol Jet Perforator is used during CTLI and is located on the First Stage Engine Dome. If the interstage fails during missile handling causing detonation of the perforator, this device will pierce the engine dome and the side of the engine. A large gash will be torn in the side and the propellant will burn with a temperature of approximately 4500 F.

2.5 ECP 77, "Lightweight G&C Components for Operational Program" has been approved, and affects the following items. Figure "A" 6701 - Interstage: Figure "A" 6204 - Nozzle Control Units: Figure "A" 6005 - Raceway Components; Figure "A" 6011 - Support Components; Figure "A" 6706 - Bracket Components; Figure "A"'s 6206 and 6207 - G& C Cable; and Figure "A" 6304 - CTLI Kit Attachment Installation.

3.0 SAFETY CONTROLS INCORPORATED

3.1 Safety features incorporated in the interstage design include the following.

3.1.1 Shields are provided to prevent fragments of interstage structure from flying toward the interior of the interstage space when the separation joints are ruptured.

3.1.2 The interstage structure is inherently grounded. A jumper also bonds the interstage to the engine. No specific safety equipment is required for the structure.

3.2 Safety markings include:

The plate provided for access to the ignition safing pin is labelled "Access First Stage Ignition Safing Pin." The location for safing of the Ordnance Assembly is labelled "Arm and Disarm Safing Pin." The window for the "Arm and Disarm Position Indicator" is so labelled. Other pertinent labels are: "Ordnance Access Door" (6 places), "Access Stage Separation, Vent", (16 places), "Panel Sling Attach" (15 places), "CTLI Equipment Access Door", "CTLI Arm and Disarm Safing Pin", "CTLI Arm and Disarm Position Indicator", and "CTLI Receptacle Cover" (3 places).

3.3 No safety procedures or emergency equipment are required.

4.0 HAZARDS AND POTENTIAL AFFECTS TO PERSONNEL AND/OR EQUIPMENT

4.1 The capability of the structure to support the missile while in an erect position in the Launcher has been well-founded in the tests of EWA 5275. The capability to withstand dynamic forces has not been demonstrated.

4.2 There are many points for errors in the assembly of this item. The structure is designed sufficiently strong, however, and procedures are such that critical errors will be discovered and the other errors will be inconsequential.

4.3 The interstage could be damaged while missile is being transported or handled. It could then fail in compression while in the launcher, or it could fail from buckling during a turn in flight. If the interstage did not separate properly, it might damage the second stage.

4.4 If a missile were to be dropped, the interstage would probably not prevent an explosion likely to occur. If an interstage fails because of structural failure in the Launcher, a hazardous condition would result from missile collapse. If a structural failure occurs in flight, an international incident may occur or, at least, the missile will fall short of its target. These same results might occur if damage is done to the nozzles or other fixtures on the second stage.

5.0 CORRECTIVE ACTION REQUIRED

5.1 The following procedures have been reviewed and recommendations are:

5.1.1 The parting agent, specified on the drawing to be applied to the slip joints in the Interstage, is not identified. See 25-27201, flag note #4. It is recommended that this agent be identified on the drawing.

5.1.2 Manufacturing Technical Directive 2-1161, Application of RTV Silicone Heat Protective Insulation (PR 1910), is subject to misinterpretation. Corrective action has been taken to ensure that safety information is included.

5.1.3 Additional testing should be accomplished to determine severity of damage interstage may sustain without failure under loads.

5.1.4 It has not been demonstrated that flying fragments will not occur at rupture of the separation joints. Such fragments might damage adjacent equipment. It is recommended that a test be conducted to evaluate this potential hazard.

5.2 Equipment Reliability has been reviewed. Probability of structural integrity $\cong$ 1: Probability of structural separation of both the stages and of skirt removal = .9994, Source D2-4578, Volume II.

5.3 No deviations from Specifications are known to exist.

5.4 Relation to Over-All System Safety is dependent on:

Structural Rigidity

Joint Separability

Protection of Enclosed Items

5.5 There are no mandatory safety changes, no required inspection procedures, checkouts or tests.

BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO WS-133A

TITLE WS-133A SAFETY ANALYSIS REPORT (FIGURE "A" 6901)

SKIRT ASSY - INSULATED STAGE I

PREPARED BY A. G. Arnold 5/21/62

SUPERVISED BY D. A. Robinson

APPROVED BY D. A. Robinson (DATE)

Released by
Weapon System Safety Manager N. E. Classon

5-78100-7090-60871-0-26340
(CHARGE NUMBER)

AF 04 (647) -289
Contract Number

SAFETY ANALYSIS FIGURE "A" 6901

SKIRT ASSEMBLY - INSULATED STAGE I

1.0 IDENTIFICATION

Boeing Drawing 25-27207, Sheet 1 & 2 Body Section Guided Missile.
Date of Analysis May 16, 1962.

2.0 DESCRIPTION

2.1 The Skirt Assembly is located on Stage I at the base end of the missile. It consists of a truncated cone and stiffeners. The first stage engine nozzle and nozzle control unit are located inside the skirt. An access plate with quick-removable fasteners is provided so that CTLI equipment can be installed.

2.2 The function of the skirt is to support the missile and to maintain it in target position until ready to launch. It also provides for aerodynamic smoothness throughout the flight of the first stage.

2.3 The Base Adapter Ring fits on the end of the skirt and serves to guide the missile into place in the Launcher.

2.4 The Umbilical Cable connects to the skirt to provide electrical power to the missile until lift-off.

3.0 SAFETY CONTROLS INCORPORATED

3.1 The skirt is inherently grounded. A jumper also bonds the skirt to the engine. No specific safety equipment is required.

3.2 Safety Markings include "Panel Sling Attach," (12 places) "Transporter Clamp Hole" (16 places) and "Door CTLI Cable Access."

3.3 The capability of the structure to support the missile standing erect in the Launcher has been well founded in the tests of EWA 5275.

4.0 HAZARDS AND POTENTIAL AFFECTS TO PERSONNEL AND/OR EQUIPMENT

4.1 The skirt could be damaged during transportation and/or handling. It could then fail in compression while in the Launcher or in flight.

4.2 If an engine were to be dropped, the skirt would probably not prevent detonation.

4.3 If structural failure occurs to a skirt while in the Launcher, a hazardous condition will result.

4.4 A structural failure occuring in flight may damage the First Stage Engine nozzles, causing an international incident or, at least, the missile could fall short of its target.

5.0 CORRECTIVE ACTION REQUIRED

5.1 None recommended.

THE BOEING COMPANY

NUMBER D2-12298 VOL III

UNCLASSIFIED TITLE WS-133A Safety Analyses Reports

VOLUME III - Missile-Borne Equipment

MODEL NO. ______ CONTRACT NO. AF04(647)-289

ISSUE NO. 4 ISSUED TO [illegible]

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PREPARED BY

SUPERVISED BY N. E. Classon

APPROVED BY N. E. Classon

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BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO WS-133A

TITLE SAFETY ANALYSIS OF FIGURE "A" 6307

CABLE ASSEMBLY, SPECIAL PURPOSE ELECTRICAL, BRANCHED EX-7605/DSQ

PREPARED BY A. G. Arnold 5-29-61
A. G. Arnold

SUPERVISED BY D. A. Robinson
D. A. Robinson

APPROVED BY D. A. Robinson
D. A. Robinson

Released by Weapon System Safety Manager
N. E. Classon

5-78100-7090-60871-0-26340

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SAFETY ANALYSIS OF FIGURE "A" 6307
CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL, BRANCHED
CX-7605/DSQ

1.0 IDENTIFICATION AND DESCRIPTION

1.1 Boeing: Model Spec. No. S-133-1006-3-4

Boeing Drawing 25-29394-1 Cable Assembly

1.2 CTLI

1.3 Illustration:

Same as above

1.4 Basic Features:

1.4.1 Physical

The cable assembly is mounted on the forward end of the First Stage Engine. It consists of a modified cross terminating in four connectors. The longest portion is approximately two feet between connectors and the biggest leg contains twelve wires and one shield.

1.4.2 Purpose:

The cable assembly connects premature separation destruct components of the 1-2 interstage to the Figure "A" 6302 Electrical Cable Assembly Set.

1.4.3 Similarity:

None known

1.5 Changes:

None

2.0 FUNCTION AND OPERATIONAL SEQUENCE

2.1 Relation to Connected Equipment:

The cable assembly serves for transmission of the premature stage separation timer initiation pulse and the timer monitor circuit to and from the Figure "A" 6303 timer, the battery activate and the battery monitor circuits to and from the Figure "A" 6210 battery, and connections to the mechanical safe and arm of the Figure "A" 6607 All Ordnance Destruct System.

2.2 Relation to Adjacent Equipment:

No effects by the cable assembly per se.

2.3 Man-Machine Interface:

The cable wires are twisted and wrapped by personnel at assembly. Also, the four connectors are installed. The connections are made up at installation of CTLI equipment and in the event of maintenance, they are disconnected.

2.4 Event Chart:

Does not apply

2.5 Alternate Modes:

None

3.0 This item has been determined to be non-hazardous and has no System Safety implications as designed if used and maintained as described in appropriate maintenance manual. This cable assembly has no direct in-line function to critical or hazardous items. Therefore, this safety analysis is considered adequate.

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BOEING AIRPLANE COMPANY

NUMBER D2-12298 MODEL NO. WS 133A

TITLE SAFETY ANALYSIS REPORT, FIGURE "A" 6310.

BATTERY ELECTROLYTE RELEASE

PREPARED BY R. G. Caley

SUPERVISED BY D. A. Robinson

APPROVED BY D. A. Robinson (DATE)

Released by Weapon System Safety Manager W. E. Classon

5-78100-7000-50371-0-26340
CHARGE NUMBER

AF 04 (647) -889
Contract Number

D2-12298
PAGE

SAFETY ANALYSIS FIGURE "A" 6310

BATTERY ELECTROLYTE RELEASE

1.0 IDENTIFICATION

Boeing Specification 10-20942-3
Model Spec. No. S-133-1006-3-3
Analysis as of July 2, 1962

2.0 DESCRIPTION

2.1 The batteries consist of a electrolytic reservoir, battery cells, and electrically actuated gas generator squib. They are located in the interstage and instrumentation sections. These batteries are installed in the dry charged unactivated condition and will be activated before missile launchings by means of electrical impulse from remote locations. They will furnish electrical power to missile components during limited system checkouts and while the missiles are airborne.

2.2 The batteries are installed during missile assembly and are activated as early as six hours prior to launch, certain prelaunch tests and checks are performed and then the batteries are permitted to stand activated until final count down, and provide electric power as required throughout the flight.

3.0 SAFETY DEVICES INCORPORATED

The batteries have been analyzed and found to have no direct safety devices or provisions when used for the purpose intended according to the established procedures.

4.0 HAZARDS AND POTENTIAL EFFECTS TO PERSONNEL AND/OR EQUIPMENT

Improper handling and/or testing could result in accidental activation of the batteries, causing them to become pressure vessels containing a caustic solution and requiring special handling and disposal procedures.